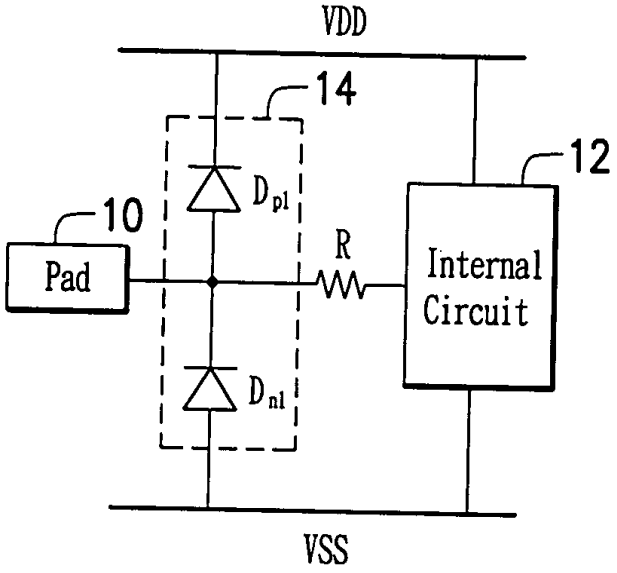


FIG. 1a (PRIOR ART)

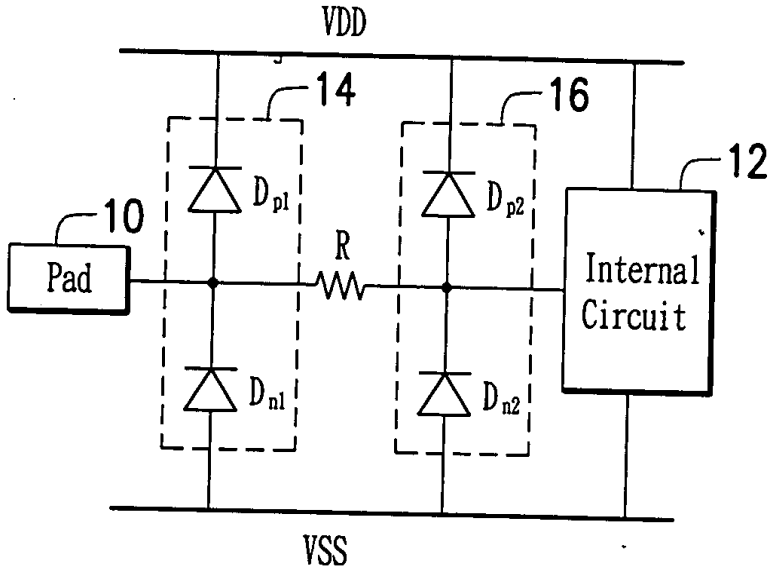


FIG. 1b (PRIOR ART)

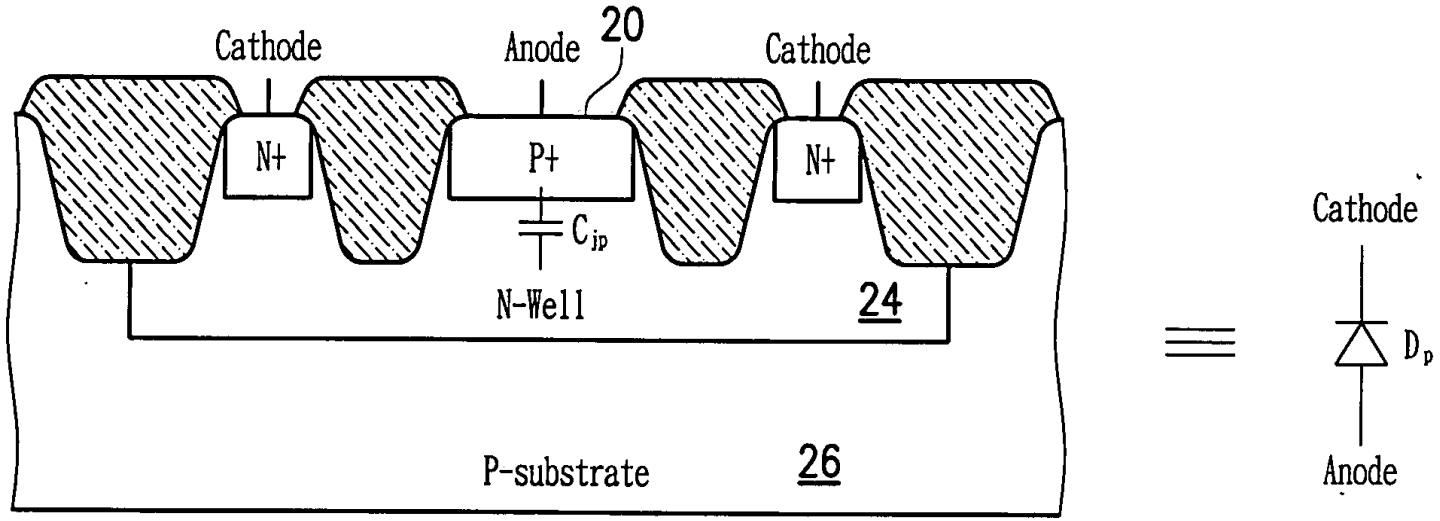


FIG. 2 (PRIOR ART)

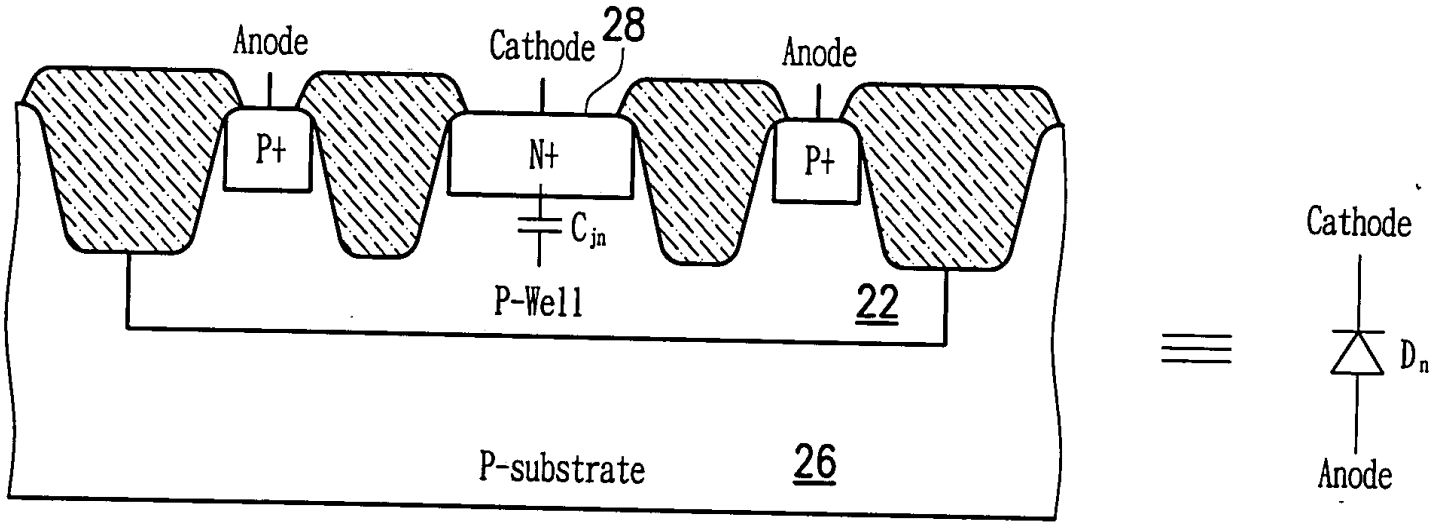


FIG. 3 (PRIOR ART)

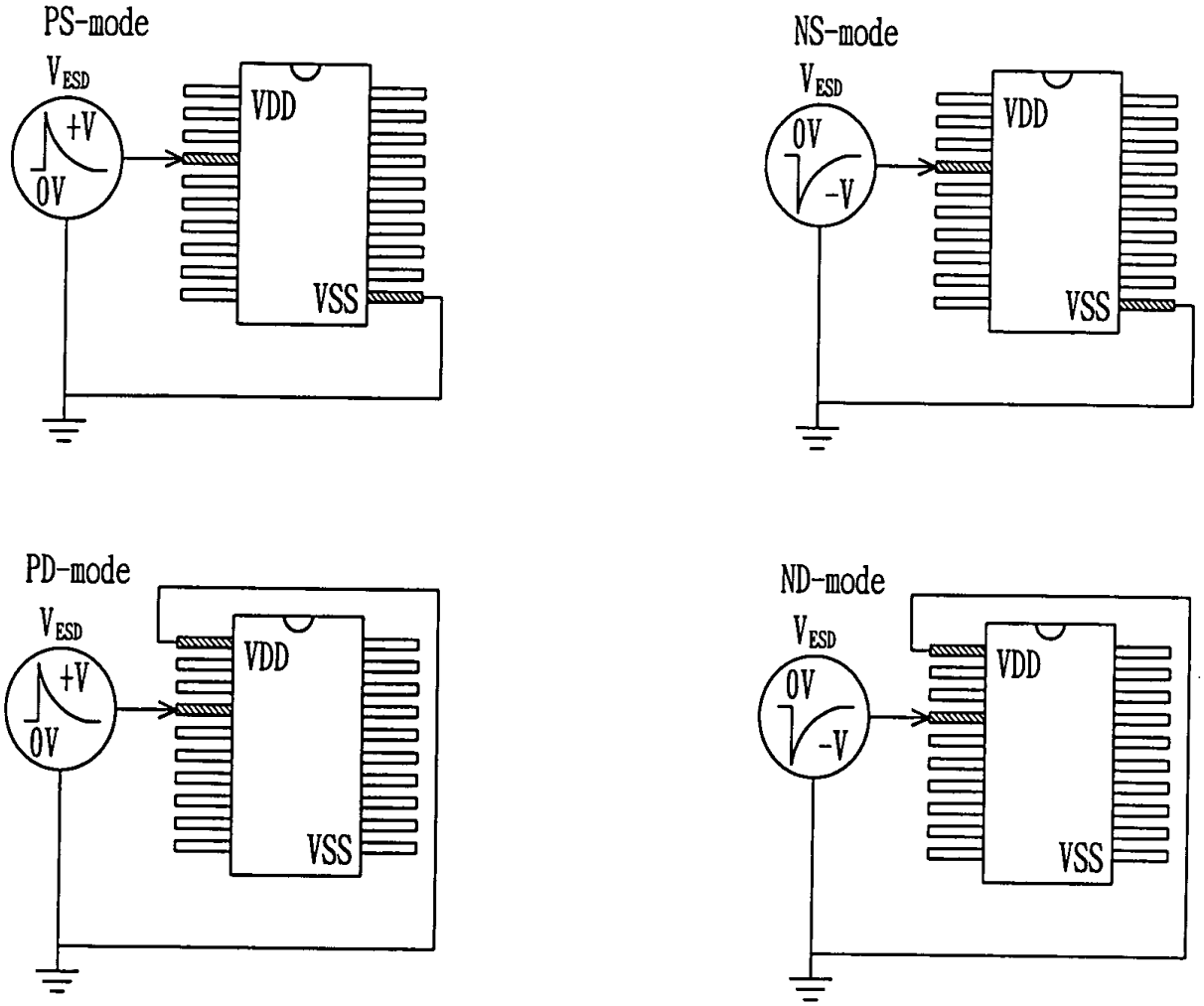


FIG. 4 (PRIOR ART)

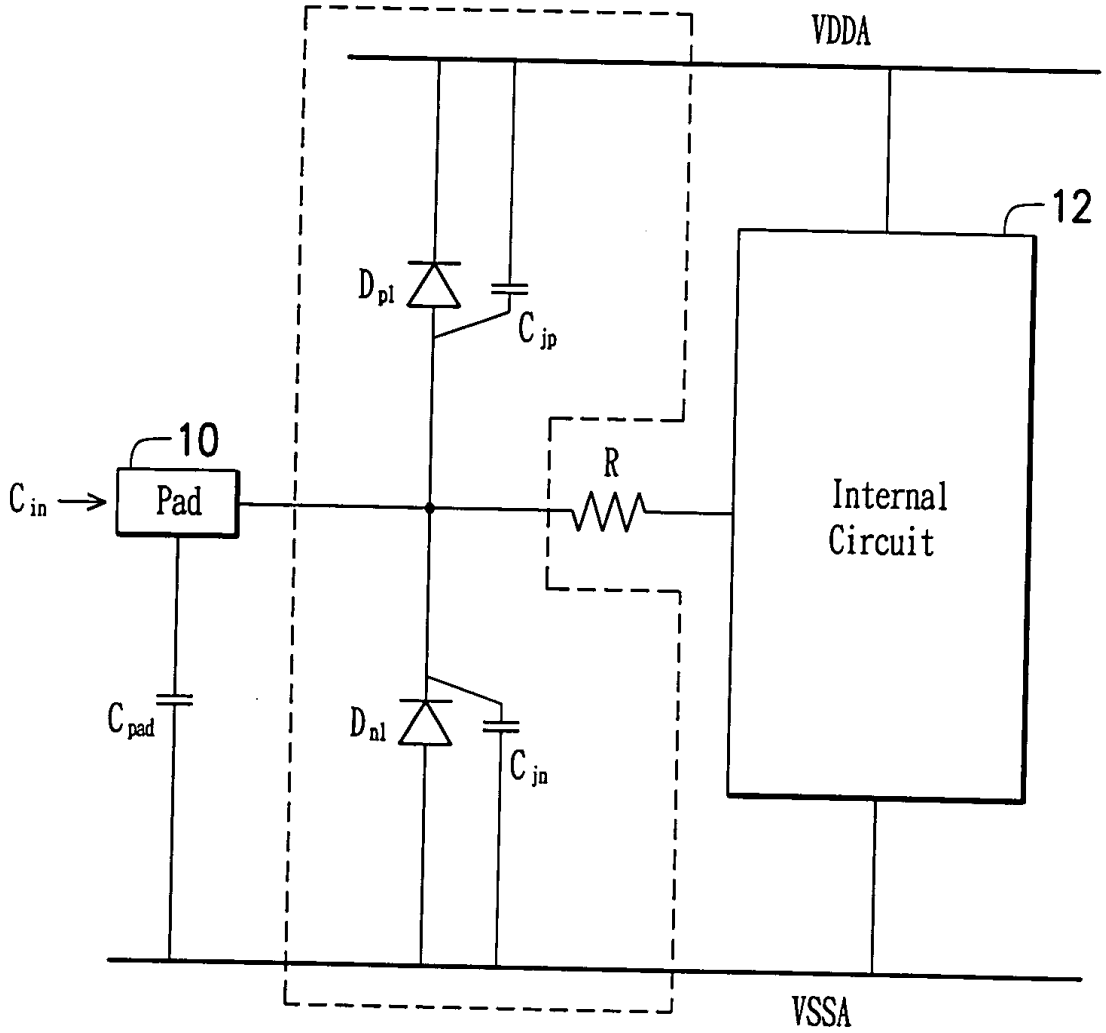


FIG. 5 (PRIOR ART)

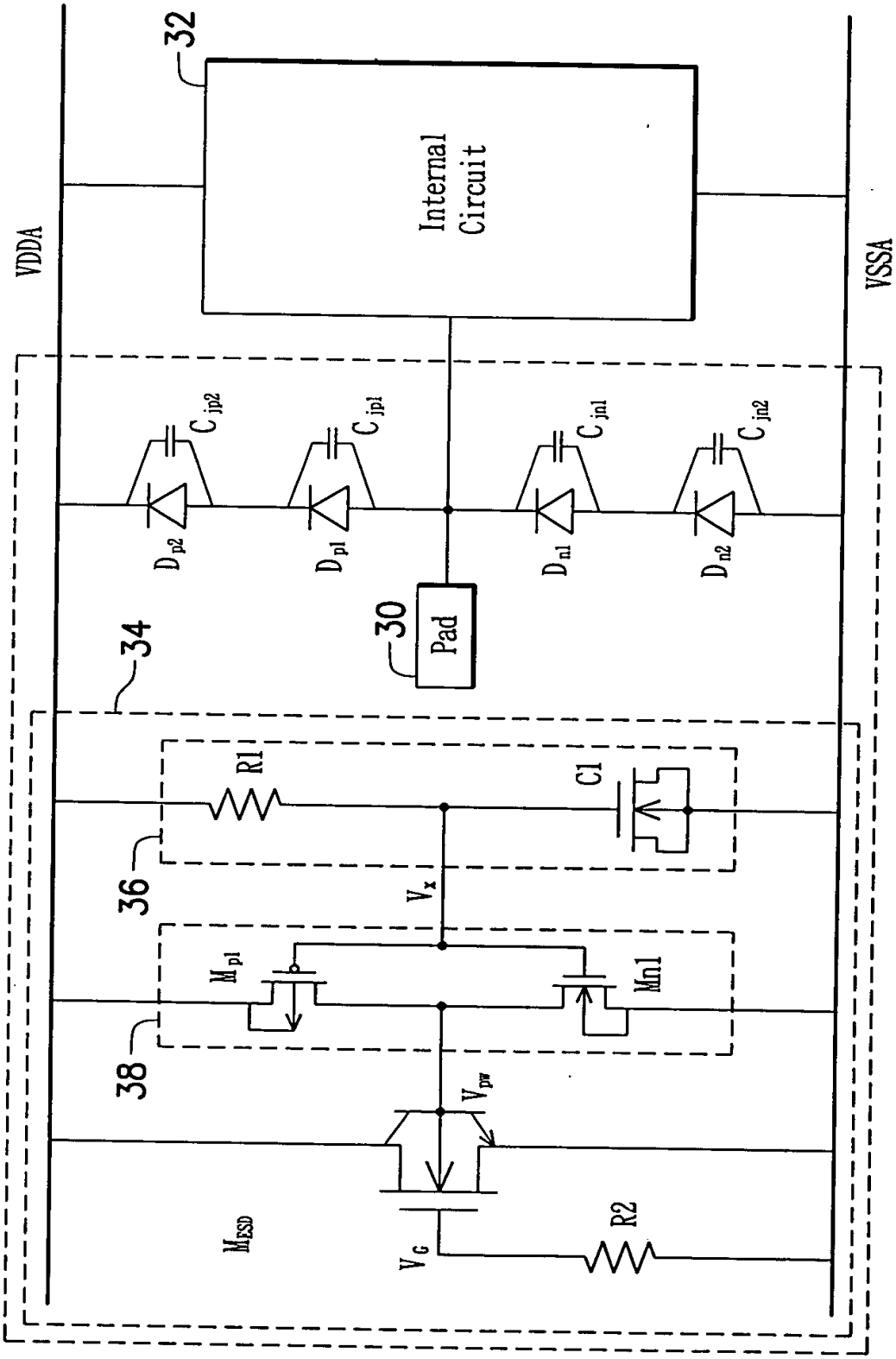

32
Internal Circuit
VDDA
VSSA
C_{jp2}
C_{jp1}
C_{jn1}
C_{jn2}
D_{p2}
D_{p1}
D_{n1}
D_{n2}
30
Pad
34
R1
C1
36
V_x
M_{p1}
M_{n1}
38
V_{pw}
M_{ESD}
V_G
R2

FIG. 6

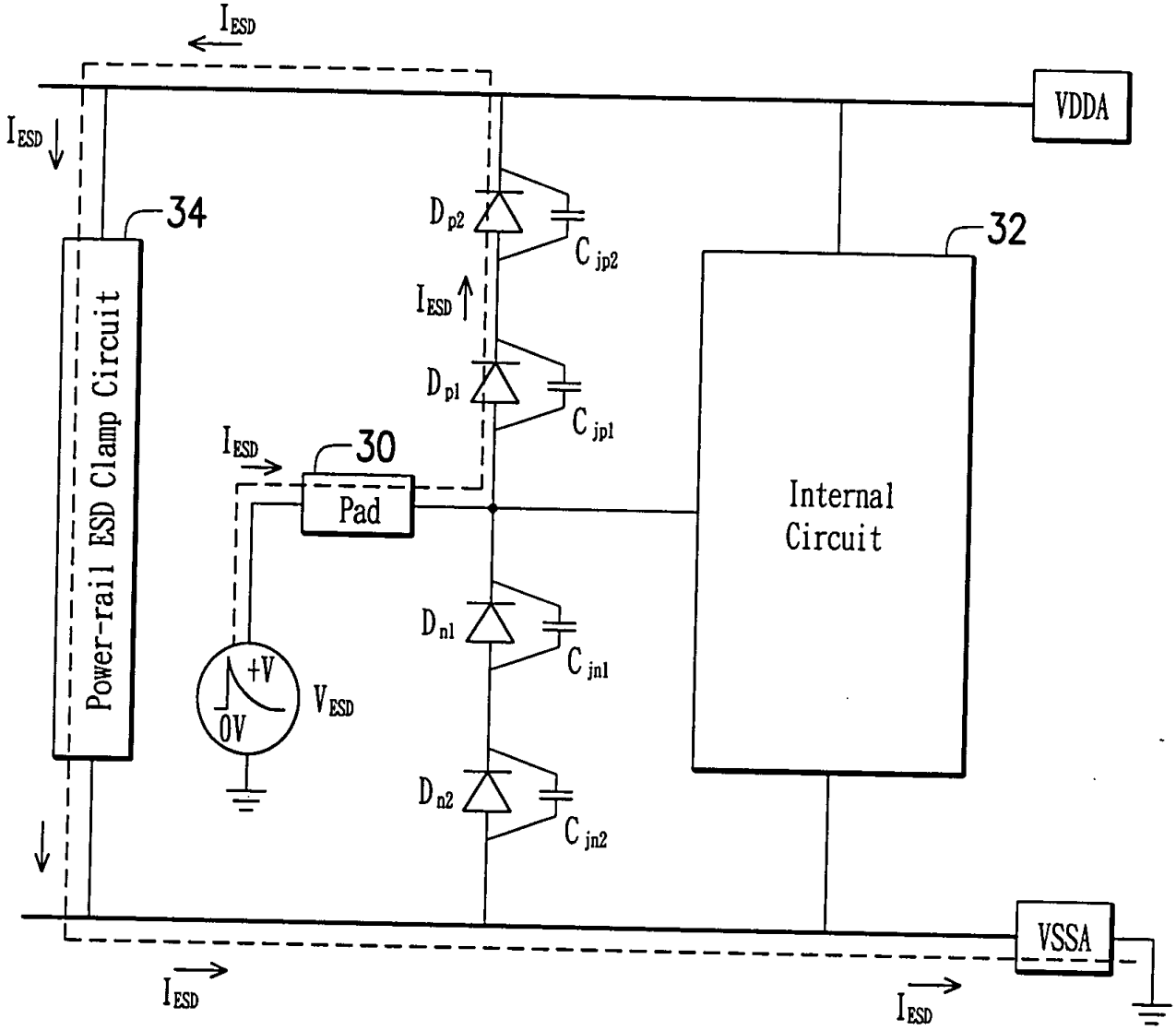


FIG. 7

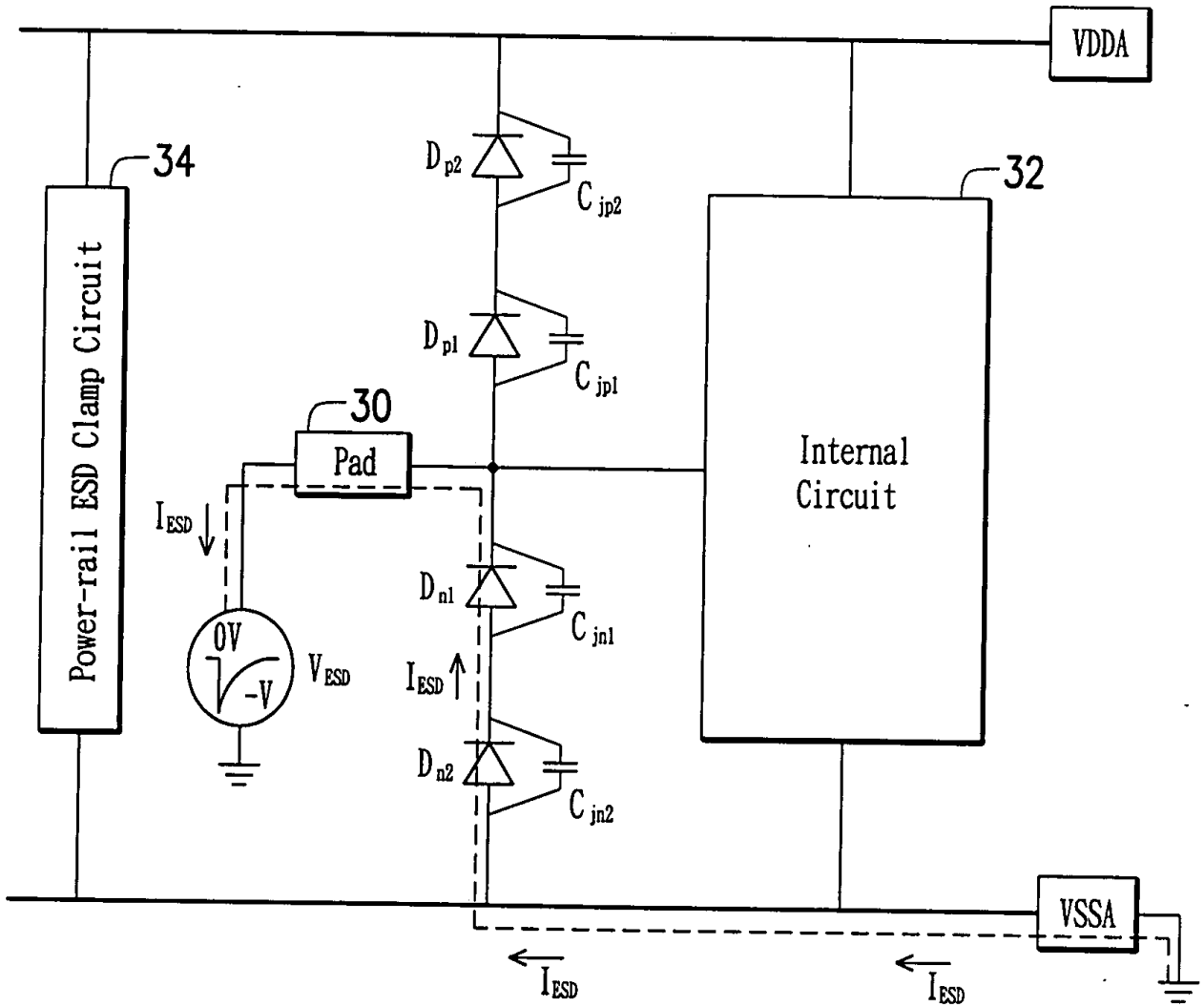
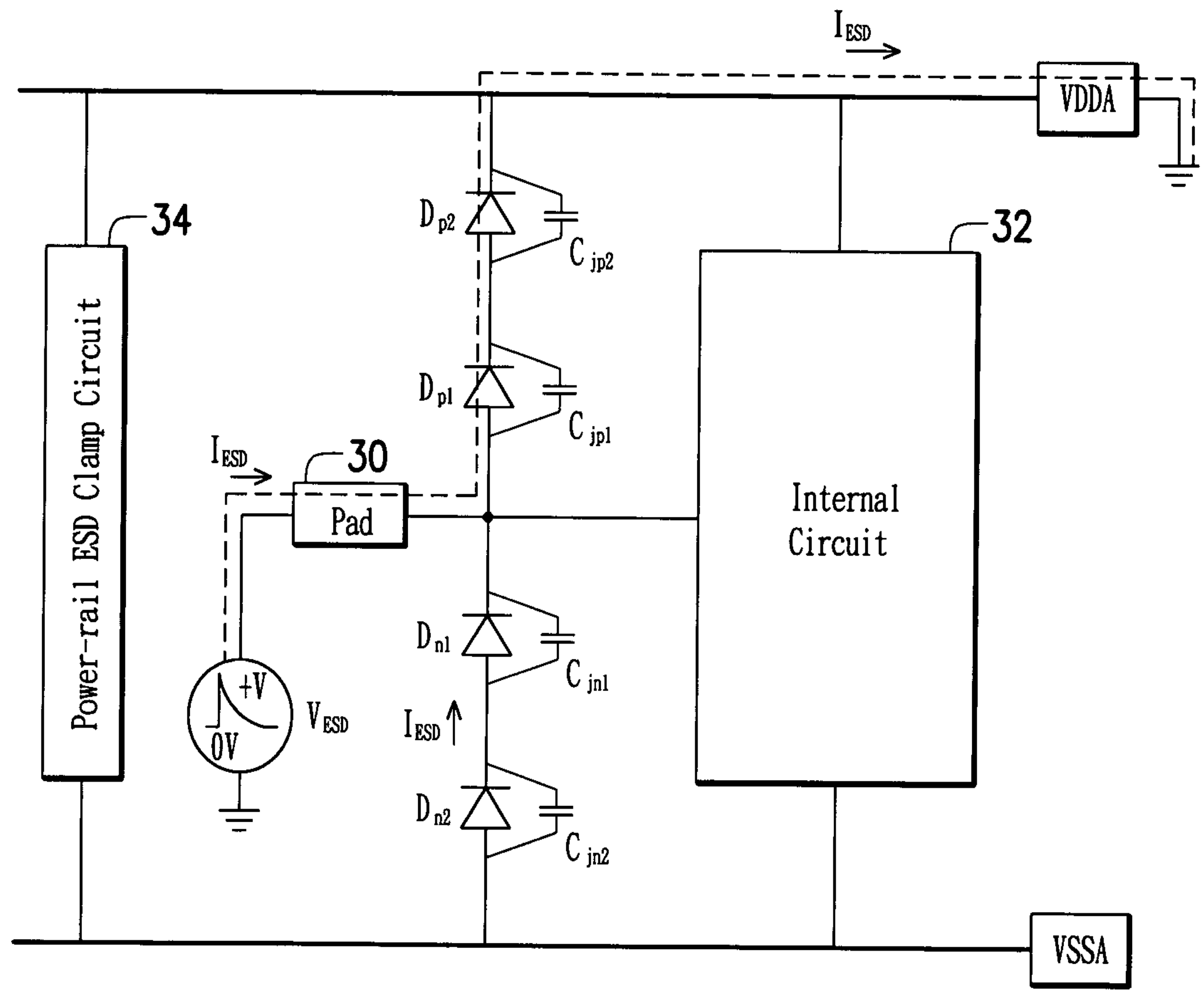
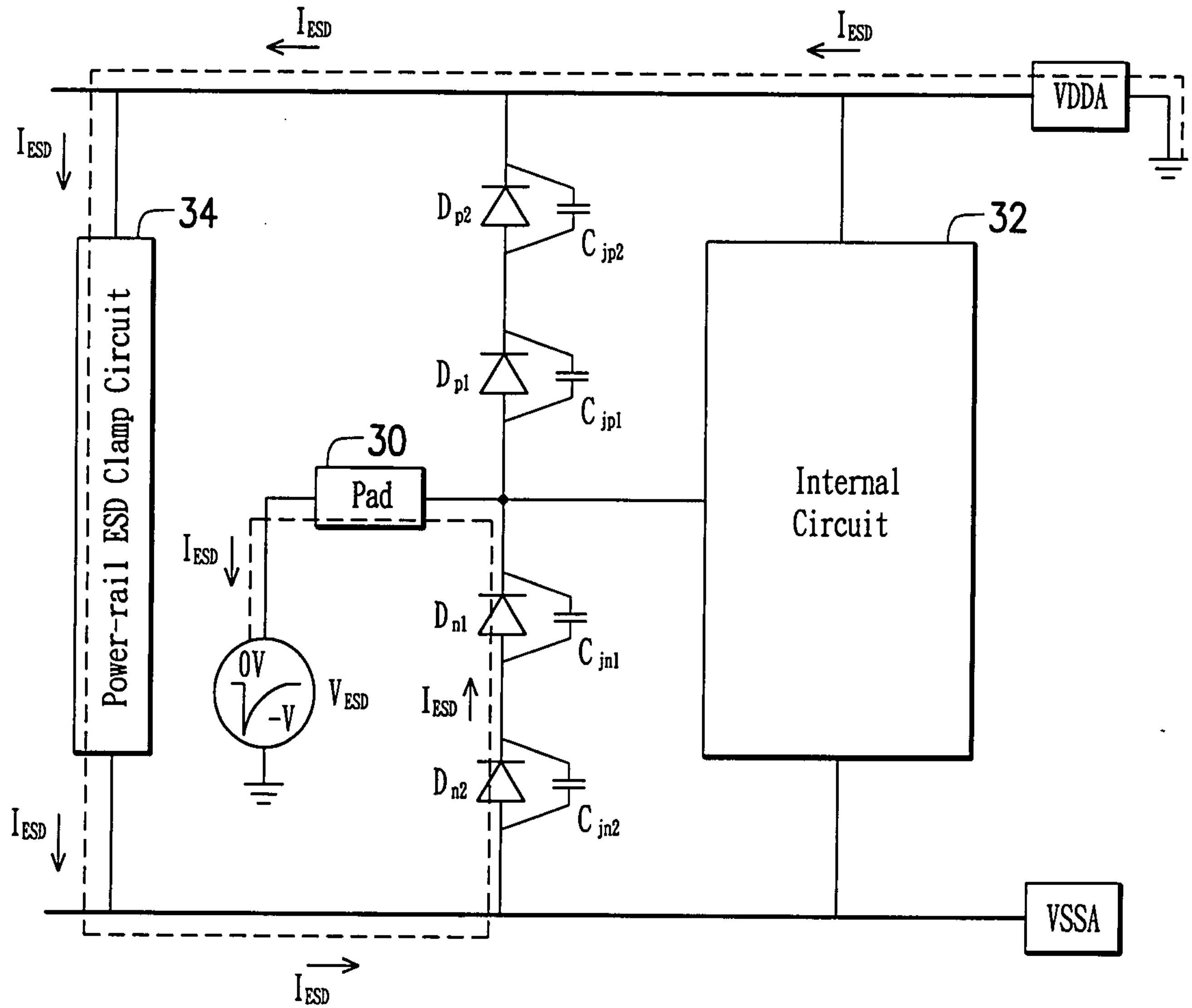


FIG. 8



I_ESD
VDDA
34
Power-rail ESD Clamp Circuit
D p2
C jp2
D p1
C jp1
I_ESD
30
Pad
+V
0V
V_ESD
D n1
C jn1
I_ESD
D n2
C jn2
32
Internal
Circuit
VSSA

FIG. 9



I_{ESD}
I_{ESD}
VDDA
I_{ESD}
34
Power-rail ESD Clamp Circuit
D_{p2}
C_{jp2}
32
D_{p1}
C_{jp1}
30
Pad
Internal
Circuit
I_{ESD}
D_{n1}
C_{jn1}
0V
-V
V_{ESD}
I_{ESD}
D_{n2}
C_{jn2}
I_{ESD}
VSSA
I_{ESD}

FIG. 10

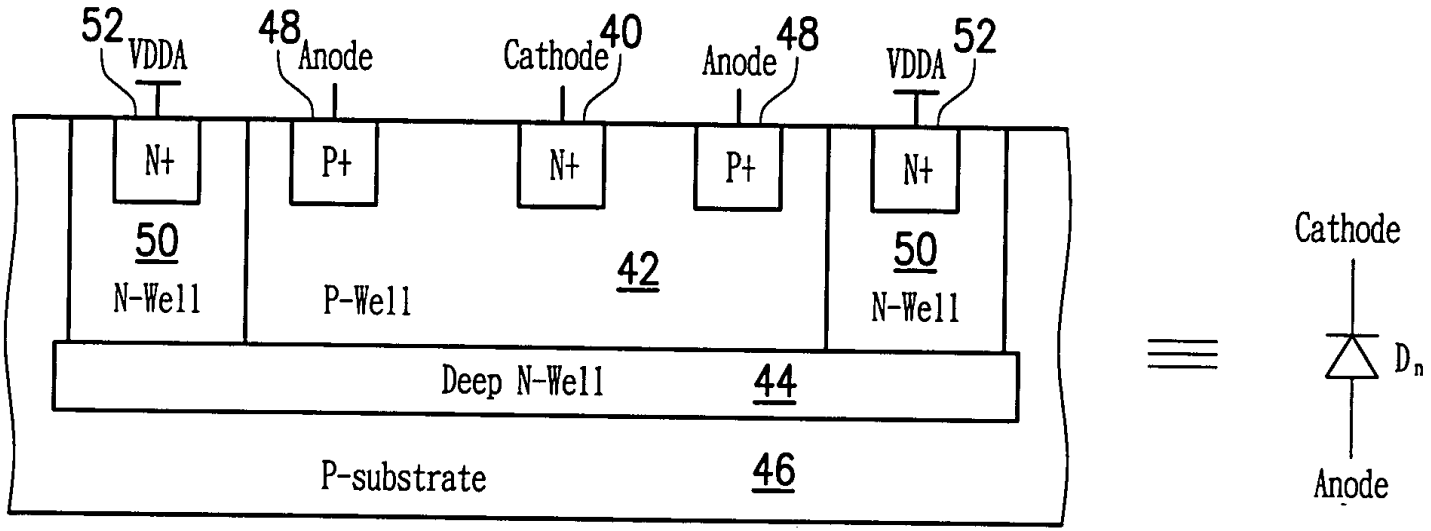


FIG. 11

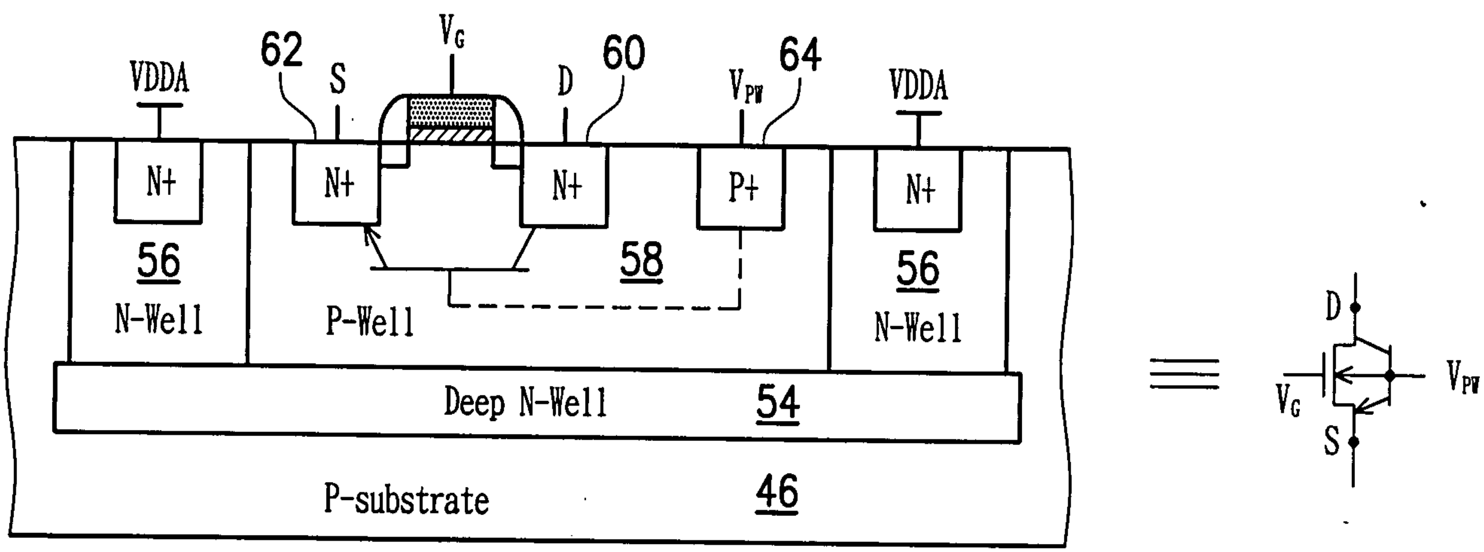

VDDA
62
S
V_G
D
60
V_{PW}
64
VDDA
N+
N+
N+
P+
N+
56
N-Well
P-Well
58
56
N-Well
Deep N-Well
54
P-substrate
46
D
V_G
V_{PW}
S

FIG. 12

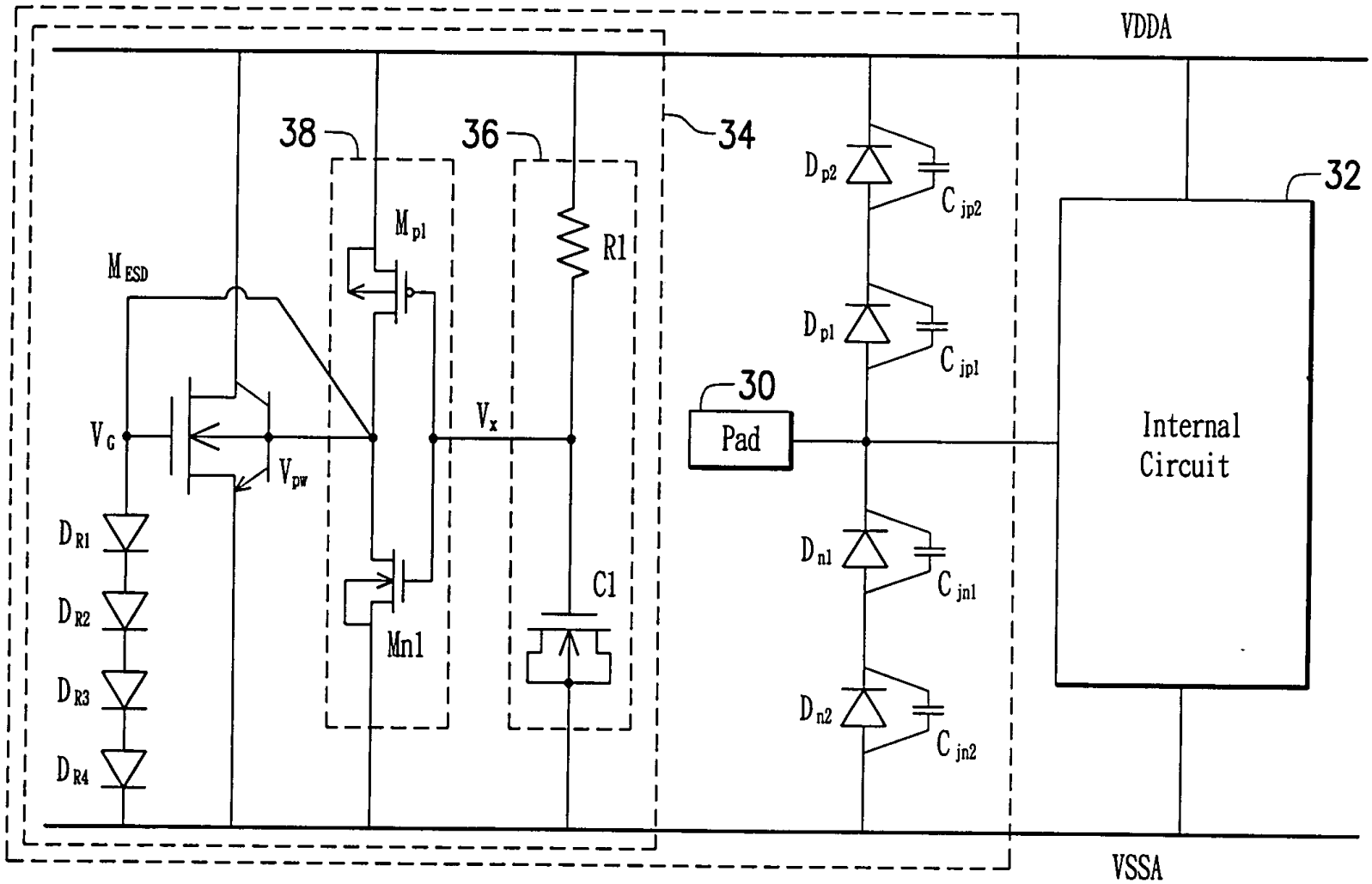


FIG. 13

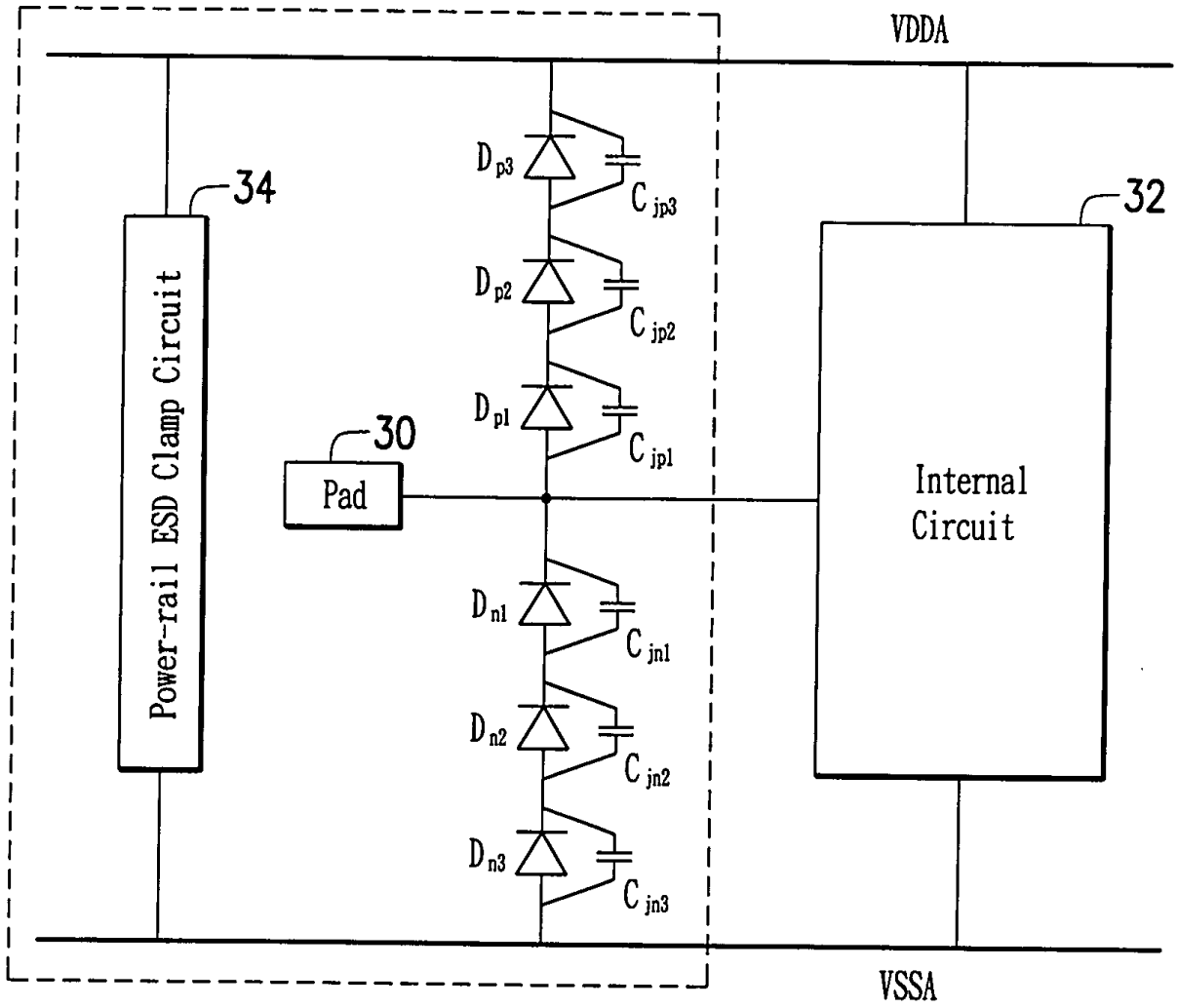


FIG. 14

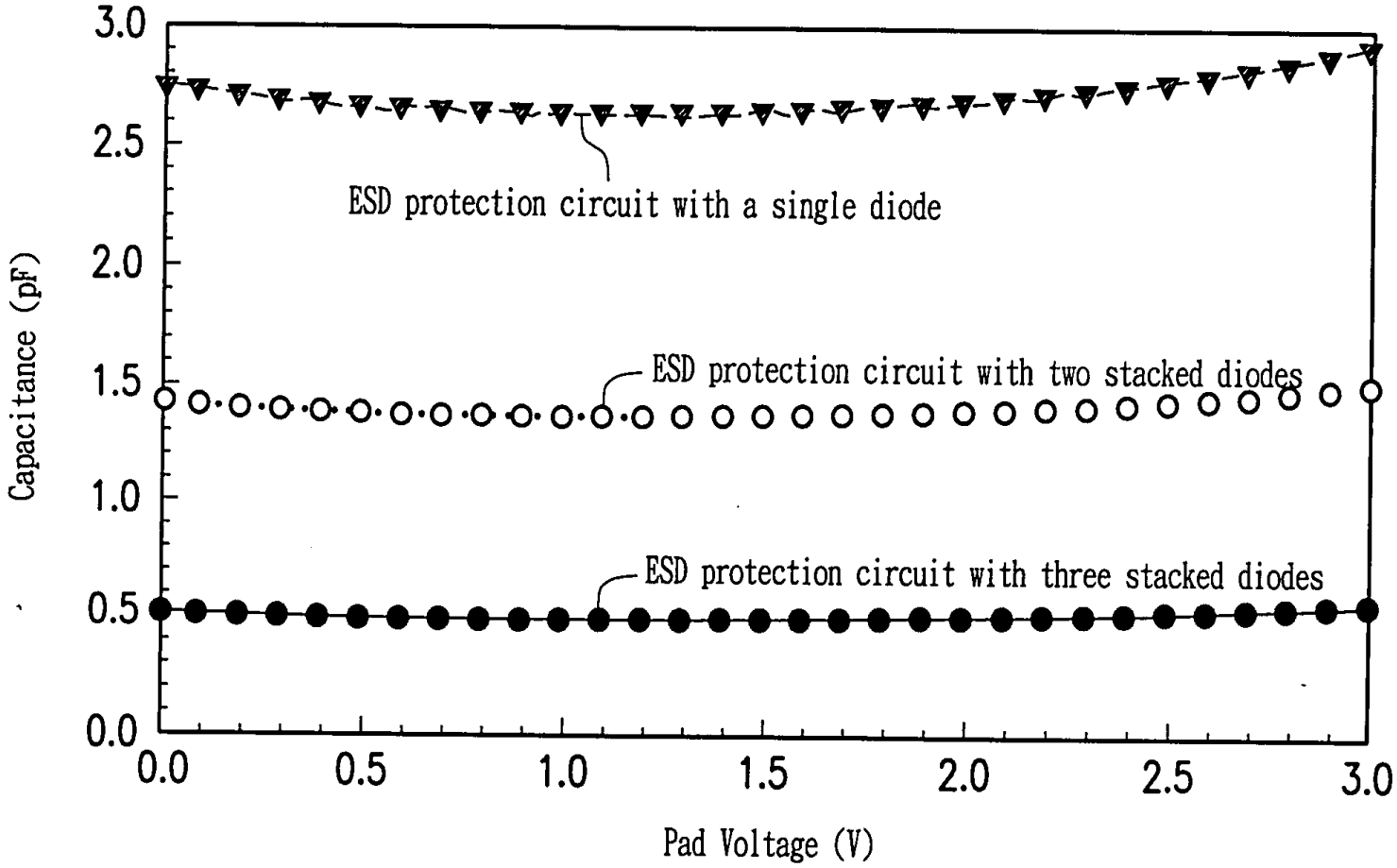

3.0
2.5
2.0
1.5
1.0
0.5
0.0
Capacitance (pF)
ESD protection circuit with a single diode
ESD protection circuit with two stacked diodes
ESD protection circuit with three stacked diodes
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Pad Voltage (V)

FIG. 15

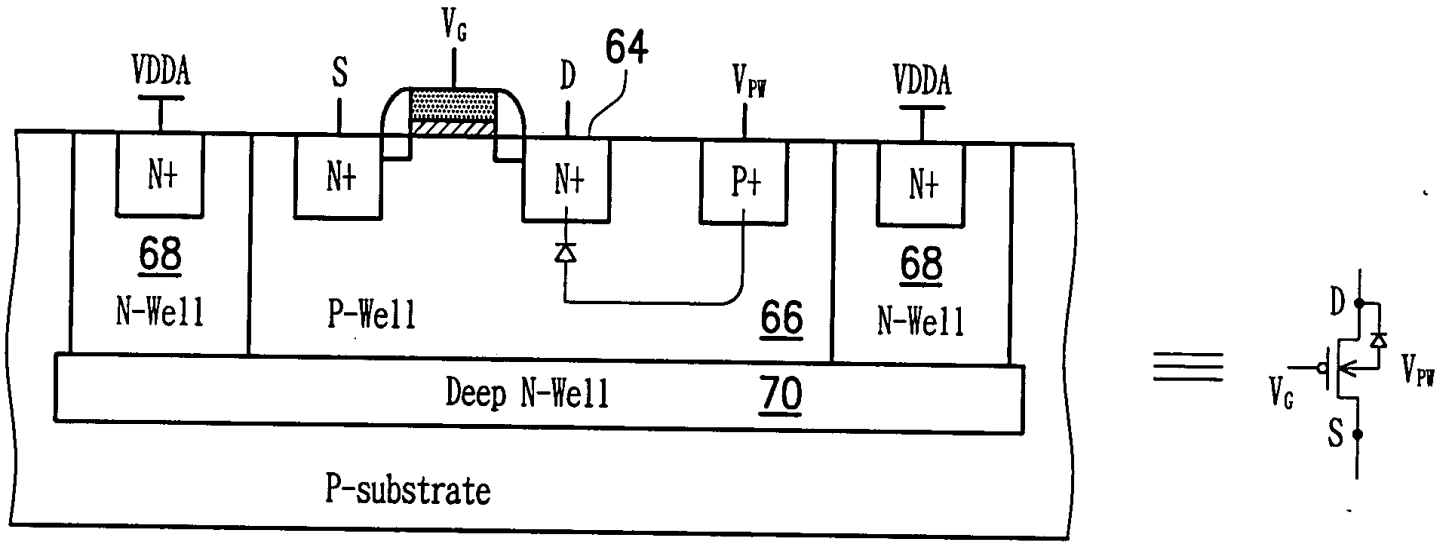

VDDA
S
V_G
D
64
V_{PW}
VDDA
N+
N+
N+
P+
N+
68
N-Well
P-Well
66
68
N-Well
Deep N-Well
70
P-substrate
D
V_G
V_{PW}
S

FIG. 16

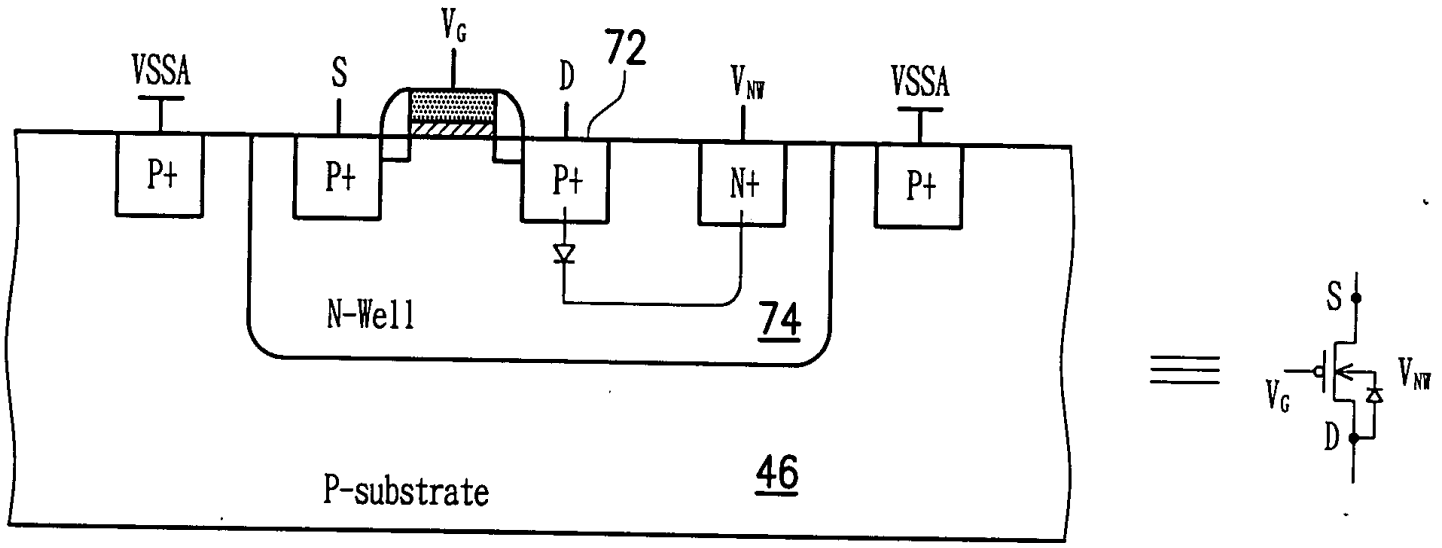


FIG. 17

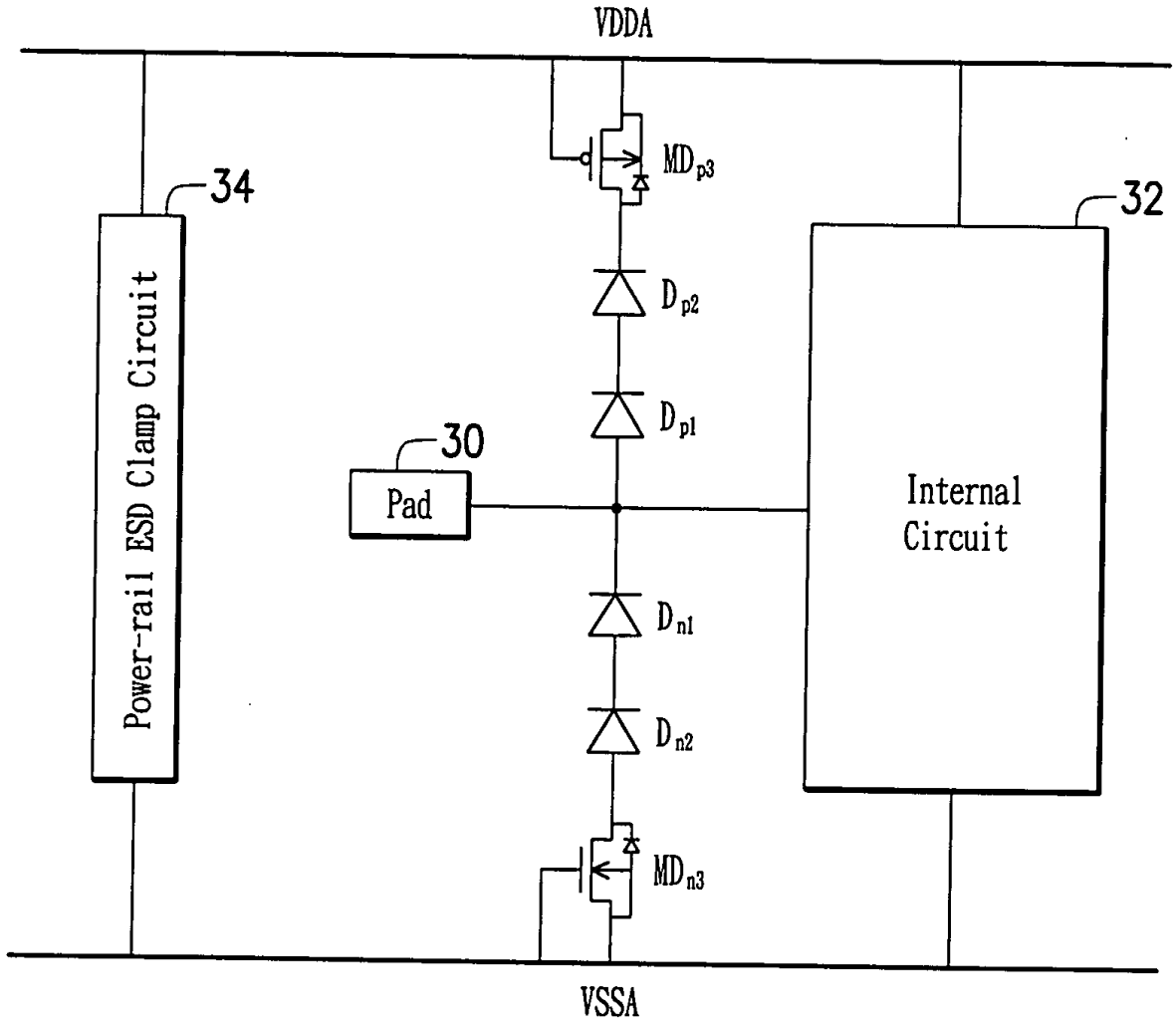

VDDA
34
Power-rail ESD Clamp Circuit
MDp3
Dp2
Dp1
30
Pad
32
Internal Circuit
Dn1
Dn2
MDn3
VSSA

FIG. 18

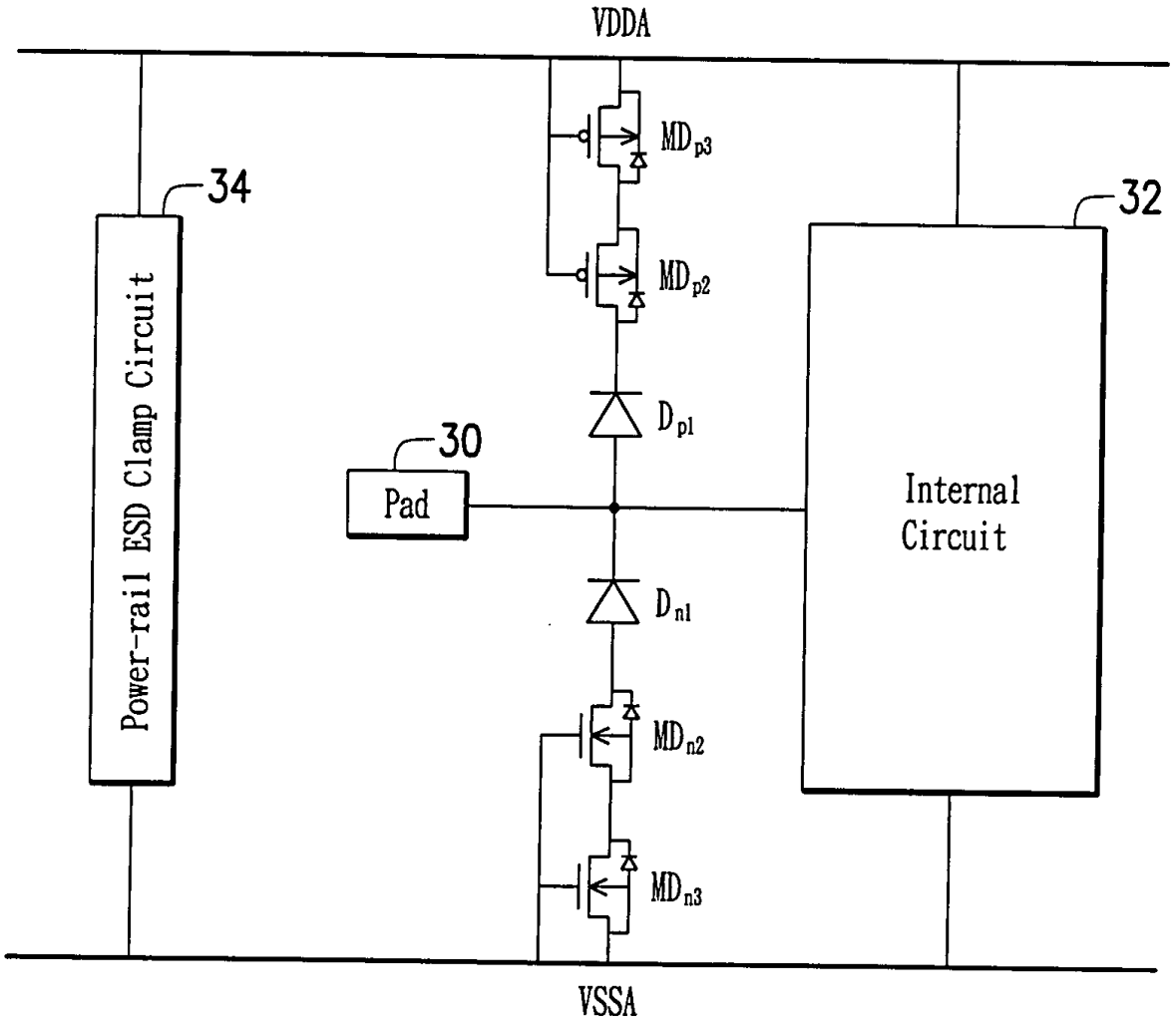


FIG. 19

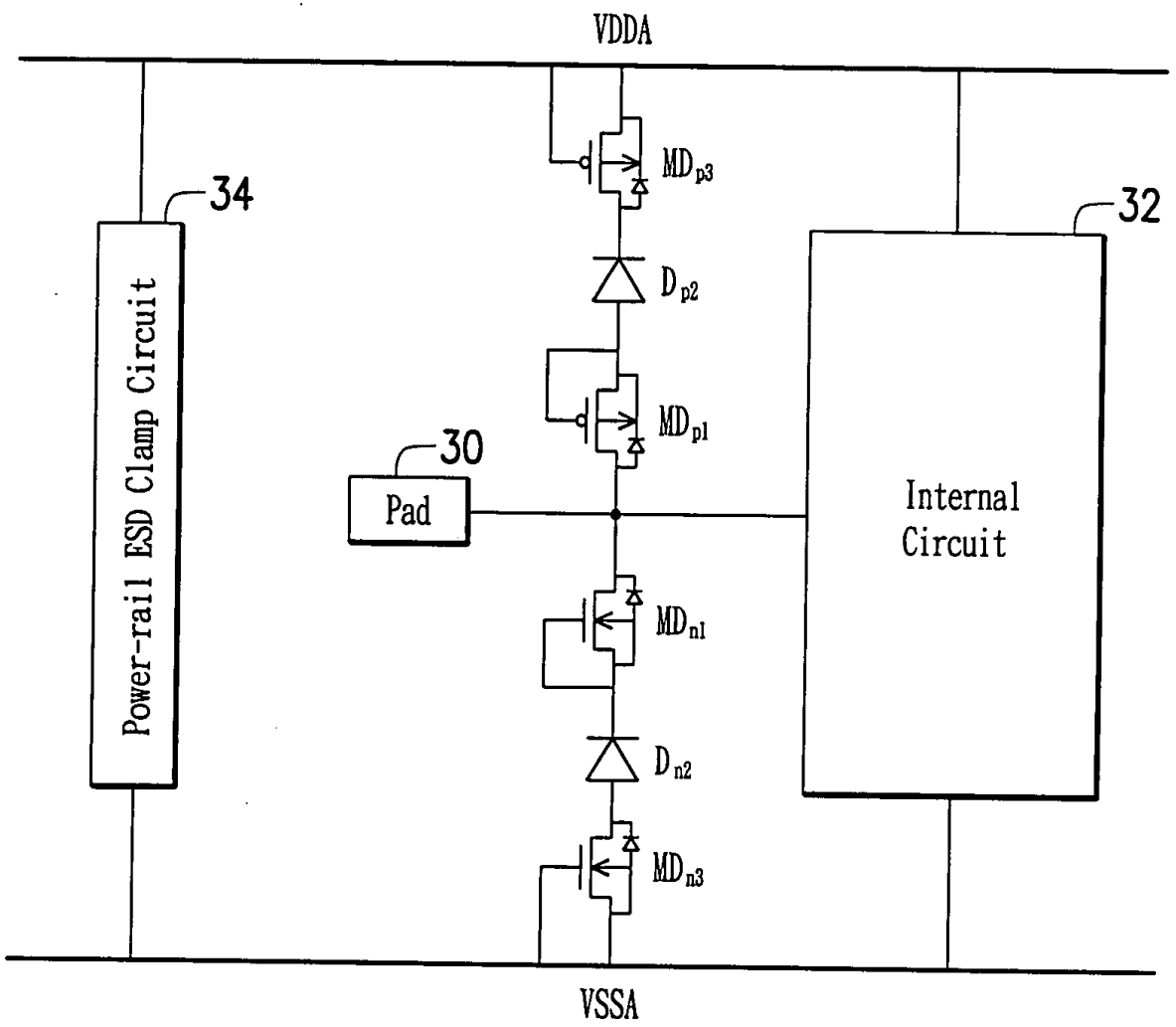


FIG. 20

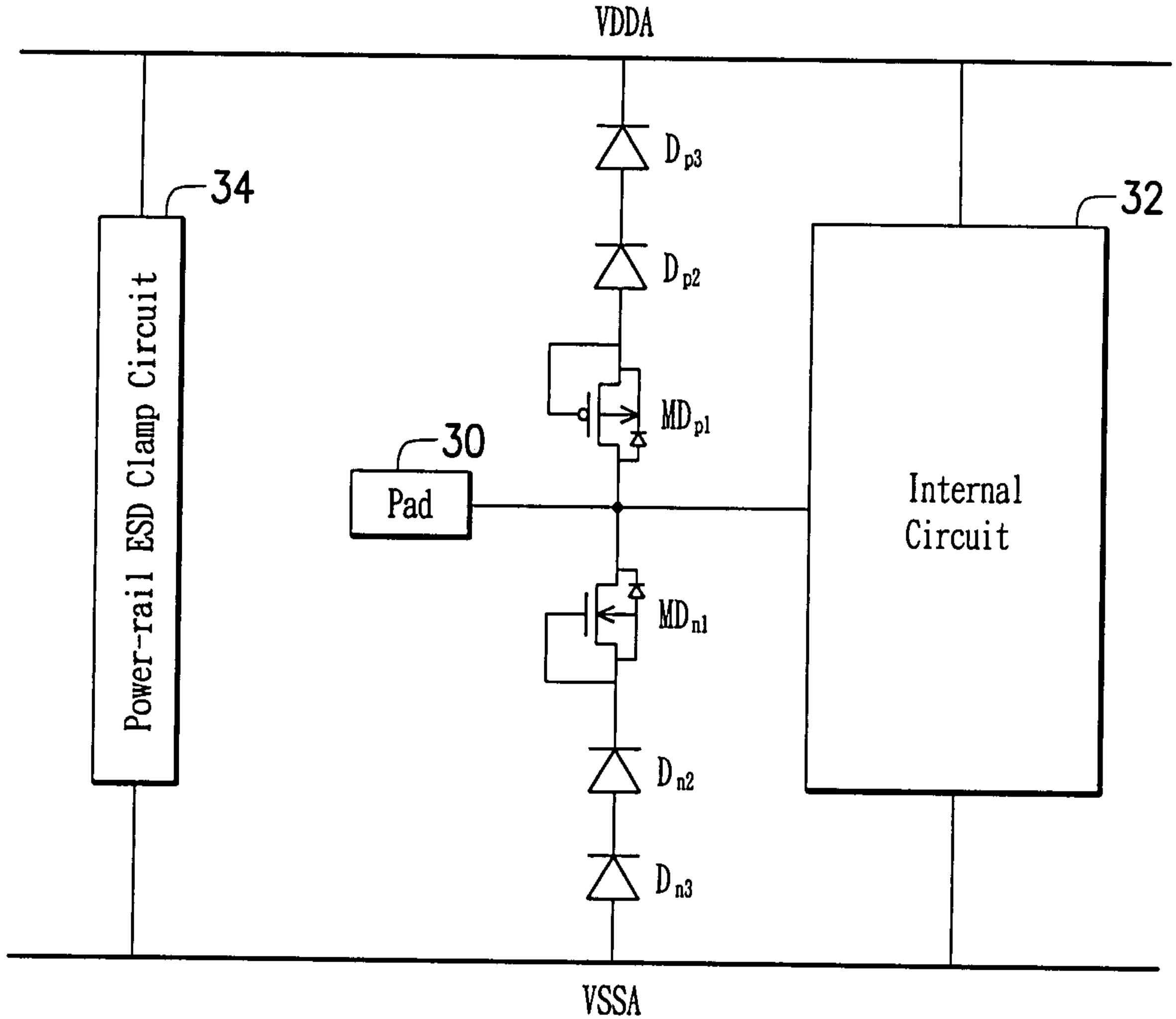

VDDA
34
Power-rail ESD Clamp Circuit
D_{p3}
D_{p2}
MD_{p1}
30
Pad
MD_{n1}
D_{n2}
D_{n3}
32
Internal Circuit
VSSA

FIG. 21

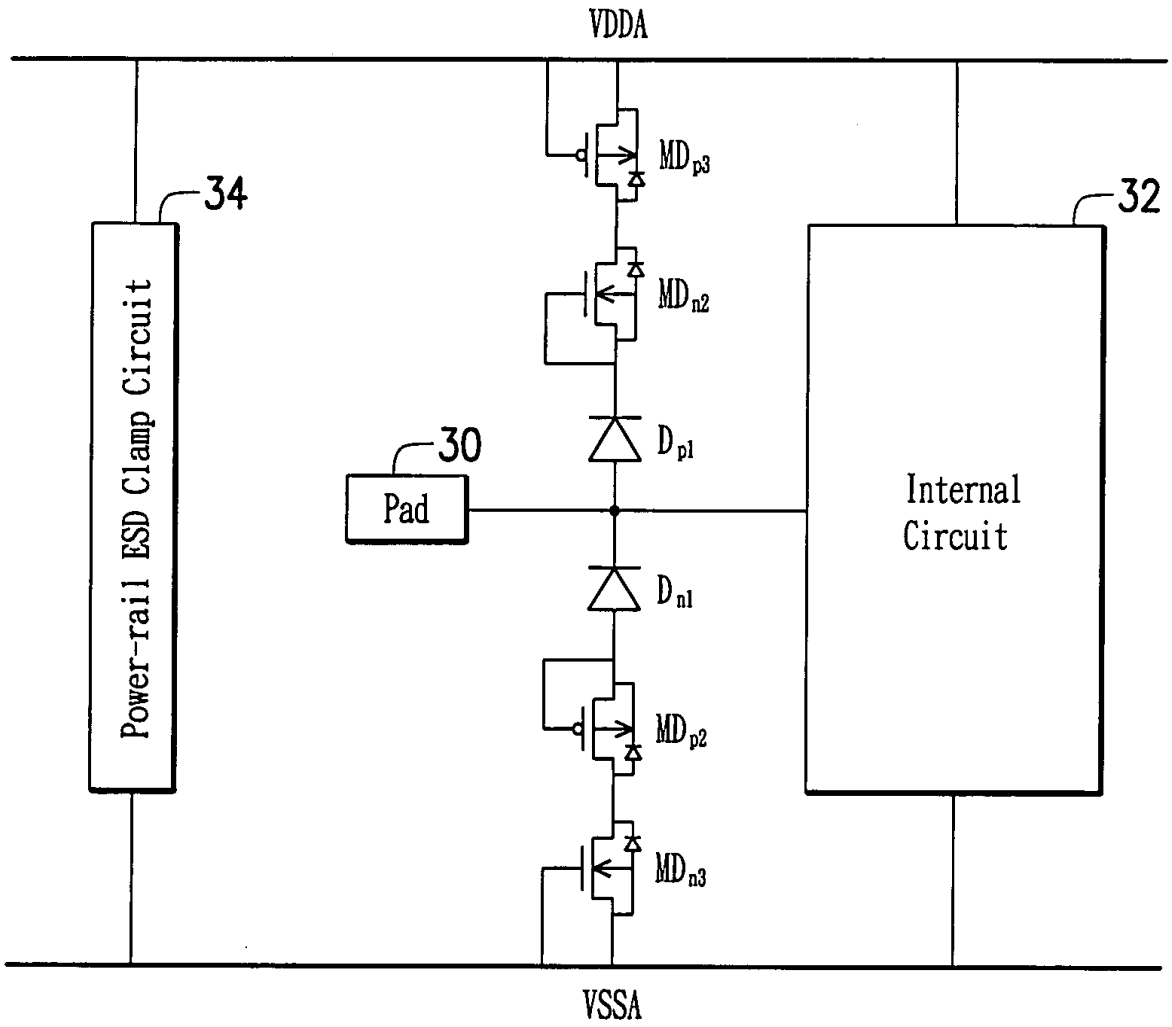


FIG. 22

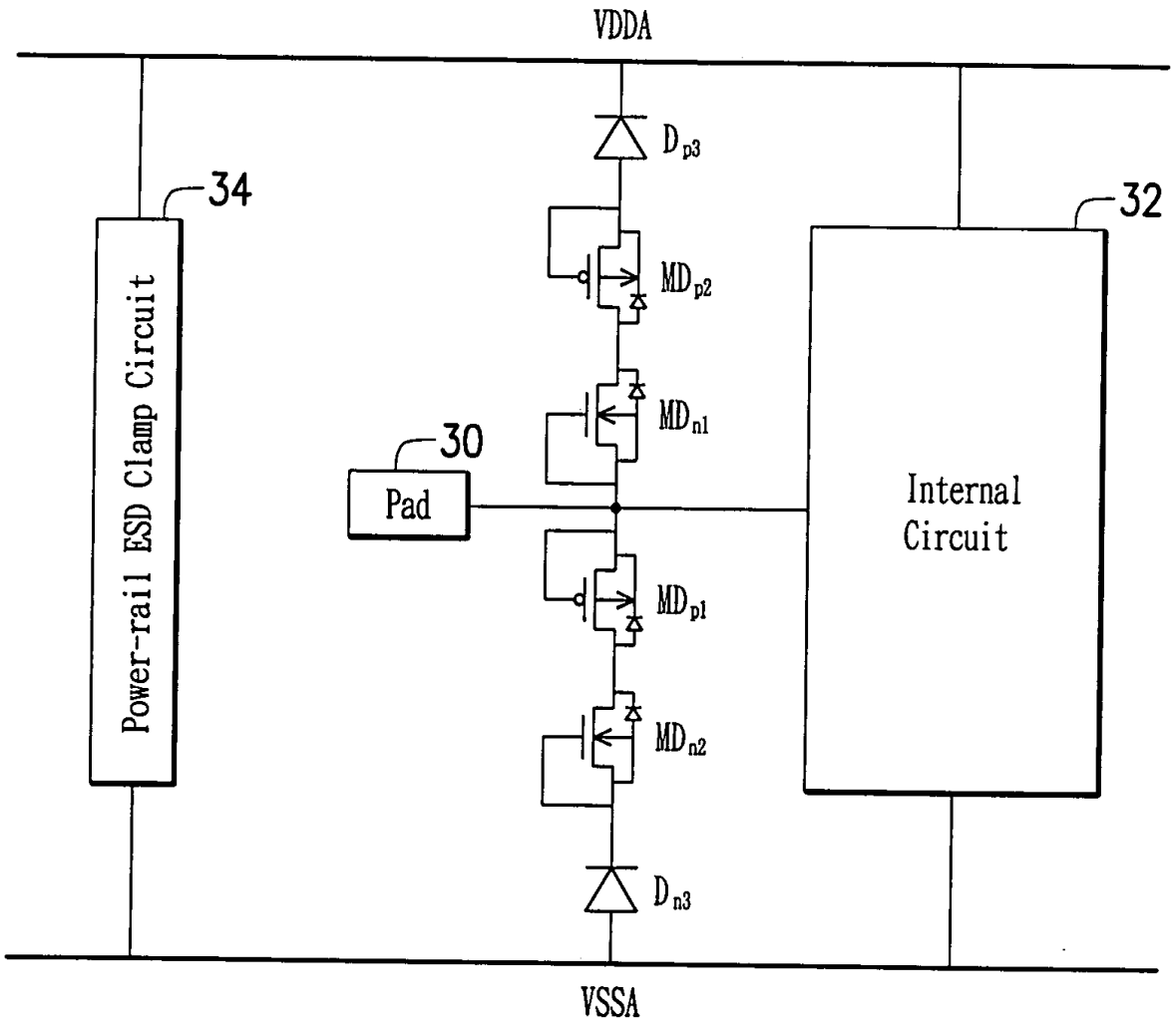


FIG. 23

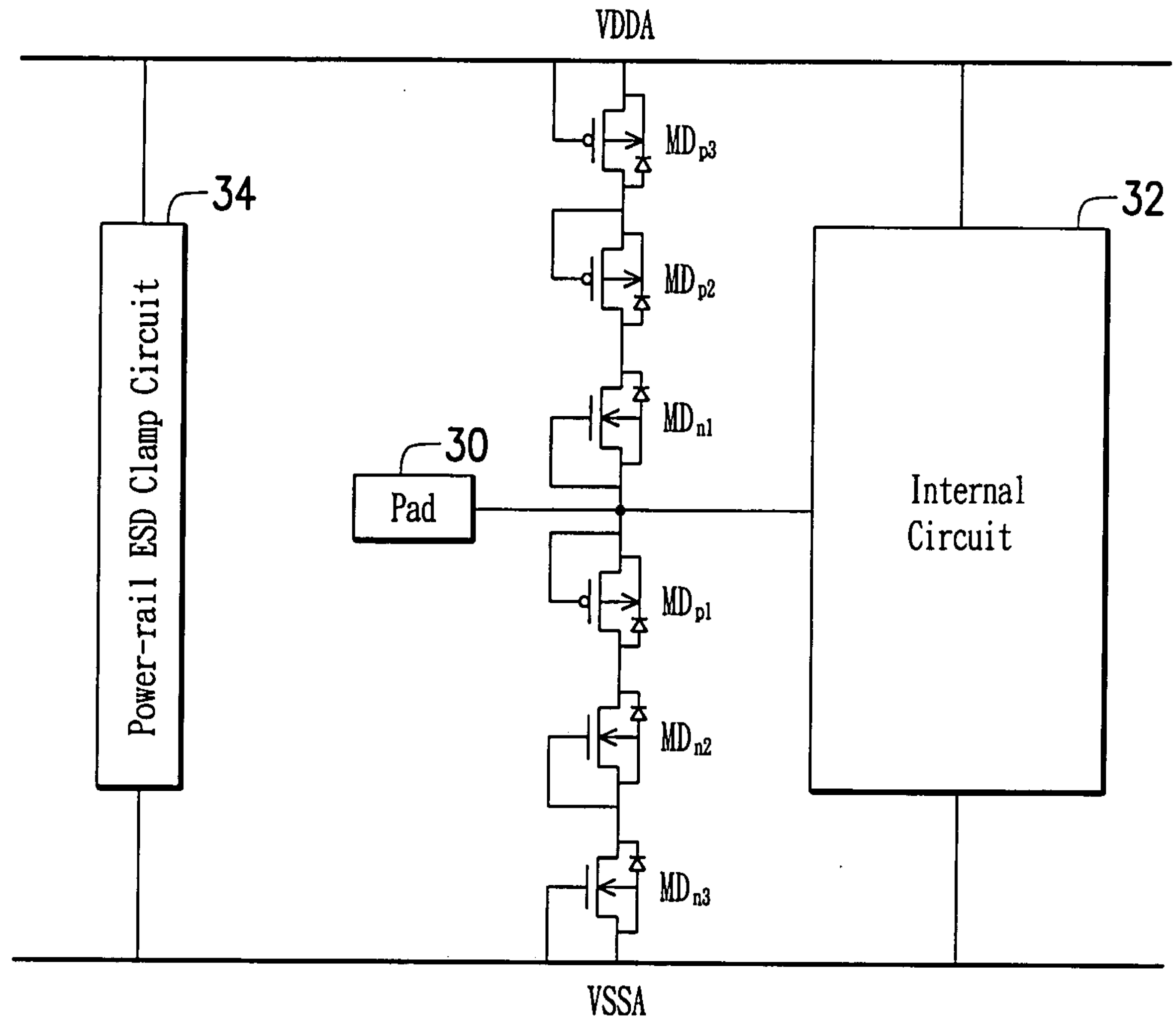

VDDA
34
Power-rail ESD Clamp Circuit
MD_{p3}
MD_{p2}
MD_{n1}
30
Pad
MD_{p1}
MD_{n2}
MD_{n3}
32
Internal
Circuit
VSSA

FIG. 24

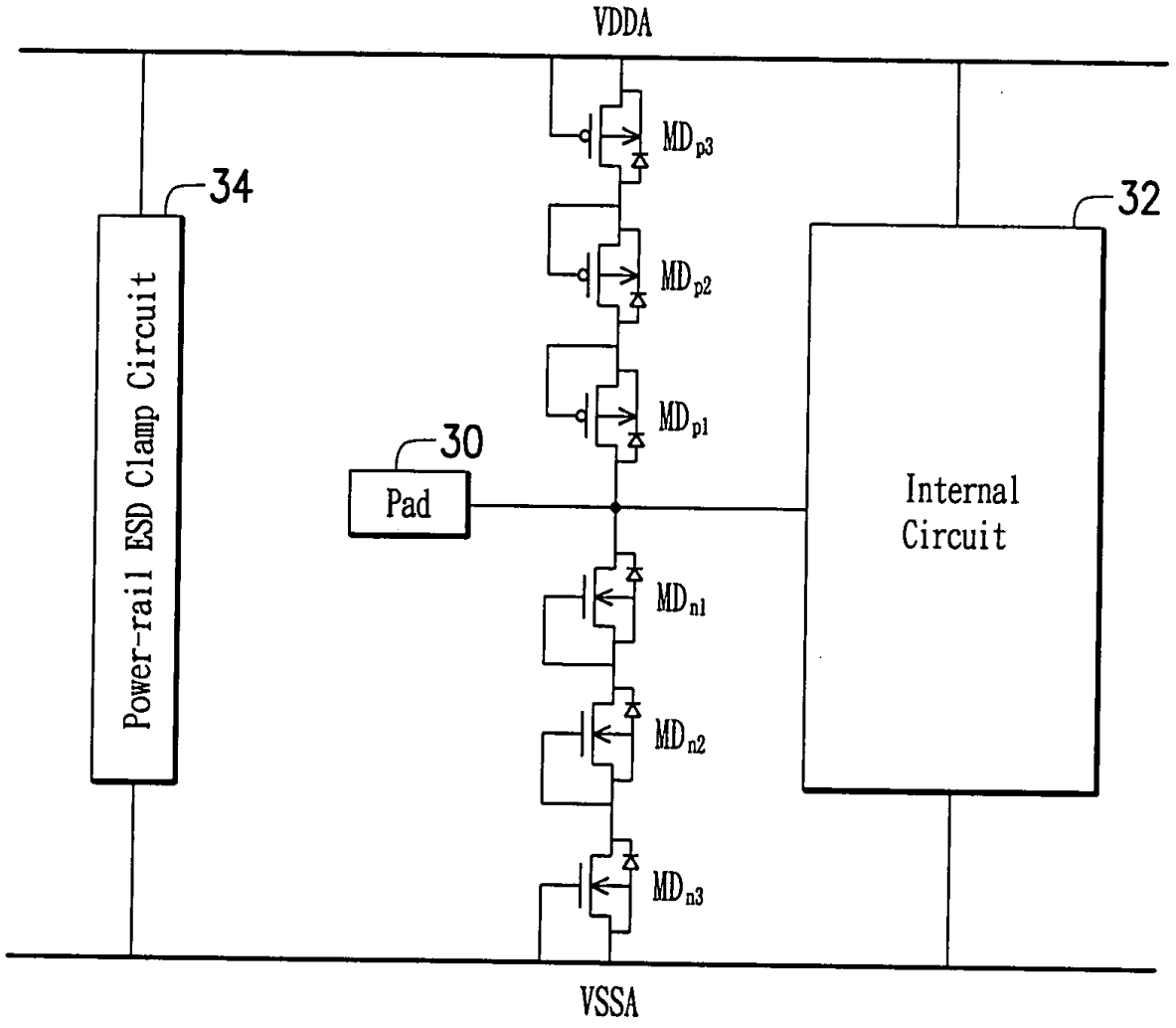

VDDA
34
Power-rail ESD Clamp Circuit
MDp3
MDp2
MDp1
30
Pad
32
Internal Circuit
MDn1
MDn2
MDn3
VSSA

FIG. 25